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**WITHSTANDING VOLTAGE TESTER**

**MODEL: GPT-515AD/GPT-515A**

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**INSTRUCTION MANUAL**



**GOOD WILL INSTRUMENT CO., LTD.**

**WITHSTANDING VOLTAGE TESTER**  
**MODEL: GPT-515AD/GPT-515A**

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## 1. GENERAL

The Withstanding Voltage Testers are for both AC voltage and DC voltage testing, with an AC output rating of 500VA. The GPT-515AD is for an AC output of 5 kV, 100 mA (500VA) or a DC output of 5 kV, 25 mA (125 W). (GPT-515A is AC only). They comply with the requirements of the Electrical Equipment & Appliance Control Ordinances and JIS, UL, CSA, BS and other overseas standards as well. They can be used for withstanding voltage test (dielectric strength test) of the various types of electrical and electronic equipment and components.

The Testers have a GO-NOGO judgement function, a test result output function, a remote control function and a safety ground function. The GO-NOGO judgement function is with a comparator. It generates an NG signal when a leak current larger than the judgement reference value set on the front panel has flowed and it also can generate an NG signal. GO-NOGO judgement can be made including to some extent such abnormal states as open circuiting or imperfect contacting of test leadwires.

Regarding the test result output function, the Testers deliver a test signal, a GOOD signal or an NG signal, all of which are contact signals. By employing the GO-NOGO judgement function in conjunction with the remote control function, an automated and labor-saving withstanding voltage test system can be realized.

The Testers, which employ a hazardously high voltage, are incorporated with the various provisions for the safety of the operator and for protection of the Testers themselves against erroneous operations. The sequency circuit is designed to be free from erroneous operations caused by noise, making the Testers highly reliable instruments.

This instruction manual is applicable to both GPT-515AD and GPT-515A. Read the items relevant to respective models.

## 2. SPECIFICATIONS

	Model		GPT-515A	GPT-515AD
Test voltage	Applied voltage		AC	AC/DC
			0 – 1.5/0 – 5 kV	
	AC	Output (with 110V AC line)	500 VA (Note 1)	
			5 kV, 100 mA	5 kV, 100 mA
		AC Waveform	AC line voltage waveform	
		Voltage regulation (with 110V AC line)	20% or better	
			(For change from maximum rated load to no-load)	
		Switching	Zero-turn-on switch (Zero-start switch) is used.	
	DC	Output (with 110V AC line)		125 W 5 kV, 25 mA
				5 kV, no load: 40 Vp-p (typical) Maximum rated load 800 Vp-p (typical)
		DC Ripples		25% or better
			(For change from maximum rated load to no load)	

Model		GPT-515A	GPT-515AD
Output voltmeter	Scales	Common for AC/DC	
		1.5/5 kV FS	
	Class	Class 1.5	
	Accuracy	$\pm 3\%$ FS	
	AC indication graduation	Mean-value response/rms-value graduation	
Safety Ground		Reject level 0.5 ohm $\pm$ 0.1 ohm; operates whenever ground is connected, (Low current AC 1.0 Amp)	
Judgement of test result (Cutoff of output by lead current detection)	Judgement system	<ul style="list-style-type: none"> <li>* NG judgement when current larger than the set value is detected</li> <li>* When NG judgement is made, the output is cut off and an NG alarm is generated</li> <li>* If no abnormal state is found during the set period, the GOOD signal is generated.</li> </ul>	
	Reference value setting	0.5, 1, 2, 5, 10, 100 mA	0.5, 1, 2, 5, 10 100 mA
		The highest range (100 mA) for AC only.	

Model		GPT-515A	GPT-515AD
	Multiplier	<p>* Each of the above setting values can multiplied up to 2.5 times continuously variably.</p> <p>* The scales are non-calibrated. Except the 100 mA ranges of both AC and DC</p>	
	Accuracy of judgement (Note 2)	* With reference to limit (set value): $\pm 5\%$	
	Detection system	Current is integrated and compared with the reference value.	
	Calibration	Calibrated for rms value of sine wave, using pure resistive load.	
Dimensions		365W x 210H x 300D mm	
Weight		approx. 26 kgs (51 lb)	

**Note 1:** The period during which the Testers can be continuously operated with their maximum rated currents is up to 30 minutes.

- Note 2:**
- (1) When the output voltage is set at a low voltage in the DC mode, larger errors may be caused by ripples. The specification accuracy is met when the output voltage is above 200V for the GPT-515AD.
  - (2) When in the AC mode, the current which flows through the stray capacitances of the output circuit and measuring leads also causes measuring errors.

### **Common Items**

#### **Test voltage waveform:**

When an AC voltage is applied to a capacitive load, the output voltage may become higher than that when in no load due to the capacitive components of the load. Especially when the load (specimen) is of a voltage-dependent capacitance type (such as ceramic capacitors), the voltage waveform may be distorted. When the test voltage is 1.5 kV, however, effects caused by a capacitance lower than 1000 pF is negligible.

#### **Test time:**

Timer setting time: 2-3 minutes (with TIMER OFF switch)

#### **Remote control:**

- (1) The test operation can be remote-controlled with the high voltage test probe.
- (2) The Testers can be set to the protected state (the state that TEST ON is disabled) by making open the protection input terminals which normally are shorted with a shorting bar.

#### Safety features:

The safety features built into the GPT-515A and GPT-515AD withstanding voltage testers are as follows:

- The security CHASSIS GROUND wire must be connected from the AC withstanding voltage tester to secure low resistance point on the unit under test.

This will allow the protection light to turn off and the withstanding voltage tester to operate. This wire parallels the normal ground wire in the power cord. To insure that both grounds are secure, 1 Amp rms at 1.5 volt AC is passed through both grounds at all times. If the total path resistance proves greater than 0.5 ohm, the protection lamp will light.

#### Leak current monitor terminals:

When checking or calibrating the cutoff current, an DC/AC milliammeter to monitor the AC or DC current may be connected to these terminals.

#### Output signals:

The types of the output signals available and the conditions of their generation are as follows:

Name of signal	Conditions for signal generation	Type of signal
TEST signal	During the period the test is performed	Make-contact signal, lamp
GOOD signal	When GOOD judgement is made, 0.5 sec	Make-contact signal, LED lamp, buzzer
NG signal	When NG judgement is made, continuous	Make-contact signal, LED lamp, buzzer



**Ambient conditions:**

Temperature and humidity to meet specified performance: 5° to 35°C (41° to 95°F), 20 to 80%

RH operatable temperature and humidity: 0° to 40°C (32° to 104°F 20 to 80% RH

**Power Supply:**

Supply voltage range: 110V, 200V, 220V, 240V  $\pm$  10%, 50/60 Hz AC

Power consumption: 15 VA or less when no load (in the reset state), Approx. 600 VA when with rated load

Insulation resistance: 30M or over, with 500 V DC

Withstanding voltage: 1,200 V AC, 1 minute

**Accessories:**

- |  |       |
|--|-------|
| • High Voltage Test Leadwires, GHT-104R      | 1 set |
| • Shorting Bar to Remote Protection Terminal | 1     |
| • Shorting Bar for Current Monitor Terminals | 1     |
| • Instruction Manual                         |       |

### **3. PRECAUTIONS BEFORE USE**

#### **3.1 Unpacking and inspection**

The Tester is shipped after being fully adjusted and inspected at the factory. Upon receiving the instrument, immediately unpack it and check for any sign of damage which might have been caused when in transportation. If any damage is found, immediately notify the bearer and, if malfunctioning is found, notify your GOOD WILL agent.

#### **3.2 Precautions for Operation**

The Tester has been designed with full attention to safety because this instrument generates a high voltage. Yet, as the instrument provides as high voltage as 5 kV to the external circuit, serious hazards are unavoidable unless the instrument is handled correctly. Be sure to observe the following when operating the instrument.

- (1) Be sure to connect securely the GND terminal to a good grounding earth line. If grounding is imperfect, the instrument when the output is shorted to the ground line or power line and hazards can be caused to the operator when he touches the instrument.
- (2) Be sure to check for that the test leadwire of the GND is not open, each time the instrument is used. Also be sure to connect at first the GND terminal to the ground line of the measured object becomes a floated state and a dangerously high voltage may be built up in the measured object.
- (3) Be sure to wear gloves whenever operating this instrument, in order to guard against electric shock hazards.

- (4) Before turning on the power switch, make it sure that the TEST VOLTAGE dial is in the counterclockwise extreme position.
- (5) Except when test is being executed, keep the TEST VOLTAGE dial in the counterclockwise extreme position. Also, press the RESET (HV OFF) button for the sake of safety. Be sure to turn off the power switch each time the instrument is not used even for a short period of time or time or when the operator leaves the instrument.
- (6) Before changing the voltage RANGE switch or the AC/DC selector switch, make it sure that the instrument is in the reset state and the TEST VOLTAGE dial is turned to the counterclockwise extreme position and the output voltmeter indication is zero.
- (7) Never touch the tested object, leadwires or the output terminals when the instrument is in the TEST ON state and the test voltage is being delivered.
- (8) Before touching the test leadwires or output terminals, be sure to check to following:
  - (a) The output voltmeter indication is zero.
  - (b) The TEST ON lamp is off.

Also short the high voltage OUTPUT terminal to the GND terminal. Especially when the test has been done in the DC mode, note that a substantial time may be needed before the electric charges stored in the filter capacitors and the tested object are discharged.

- (9) Do not short the output to the ground line or AC power line, lest the instrument housing should be charged up to a hazardously high voltage. It is permissible, however, to short the high voltage

**OUTPUT** terminal to the **GND** terminal when the instrument housing is grounded to an earth line.

- (10)** When the instrument is remote-controlled, the high voltage output is turned on with a **GHT-140R**. When operated in this mode, be extremely careful so that the high voltage output is not turned on inadvertently.
- (11)** In case of an emergency, immediately turn off the **POWER** switch and disconnect the **AC** power cord from the **AC** line receptacle.
- (12)** If the **TEST ON** lamp does not go off even when the **RESET** button is pressed, it is possible that the output is delivered regardless of the **TEST ON/OFF** control signal. When this state has occurred, immediately stop using the Tester and contact your **GOOD WILL** agent for repair.
- (13)** When the **TEST ON** lamp has failed and does not turn on, immediately replace it or contact your **GOOD WILL** agent.

To operate the instrument in good conditions for a long time, pay attention to the following:

- (1)** When in the no-load state, the maximum output voltage of the instrument becomes higher than 5 kV. An output voltage higher than 5 kV may be produced also when the **AC** line voltage has surged up. Be sure to operate the instrument with an output voltage not higher than 5 kV.
- (2)** The heat dissipation capacity of the transformer of this instrument is for one-half of the rated output, from the view-points of size, weight and cost. Therefore, continuous operation when the instrument is set at the 100 mA cutoff current range must not exceed 30 minutes, at ambient temperature 40°C (104°F). If more test time is required, pause the instrument for the same period as that it has been

used and, then, resume operation. This requirement does not apply when the lead current range is 10 mA or less.

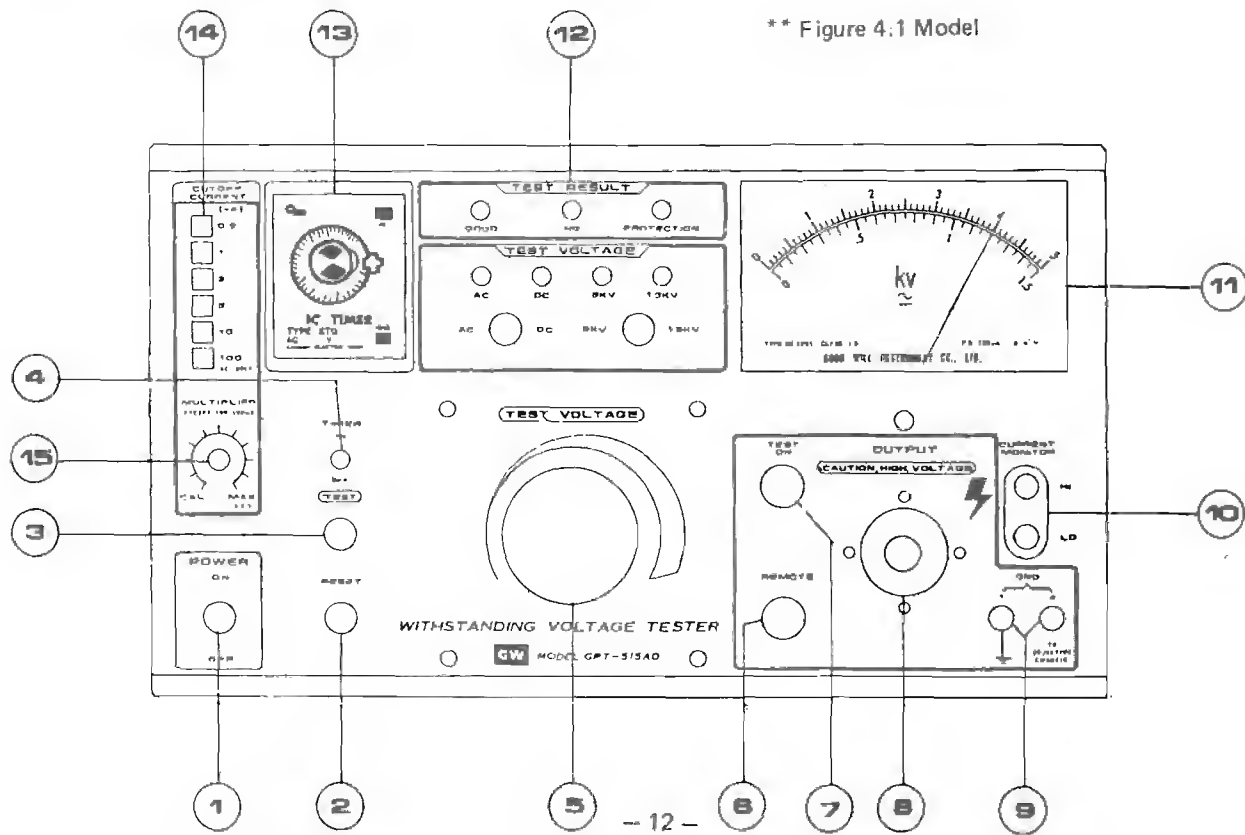
- (3) This instrument operates normally with an AC power line voltage range of  $110\text{ V} \pm 10\%$ . If the AC line voltage is not within this range, the instrument operation becomes unstable and damage may be caused to the instrument.
- (4) Do not use or store the instrument in direct sunlight, in high temperature or humidity, or in dusty atmosphere.

This instrument employs a high voltage output transformer of 500 VA. Therefore, a large input power current (several tens amperes) may flow for several tens milliseconds before the NG signal is detected and the output current is cutoff when an overcurrent has flowed in the load being tested. Pay attention to the AC line capacity taking also into consideration the other instruments and devices connected to the same AC power line.

## 4. OPERATION INSTRUCTIONS

### 4.1 Description of Front Panel

\*\* Figure 4:1 Model



**1 POWER (ON/OFF) switch):**

Main power switch of instrument. Before turning on this switch, be sure to read Section 3.2 "Precautions for Operation."

**2 RESET button (HV OFF):**

To cut off the HV output when in test operation, press this button. This button is used also to reset the NG alarm state or the PROTECTION state.

**3 TEST button:**

As you press this button when the instrument is in the reset state, the TEST ON lamp lights and the test voltage as set by the TEST VOLTAGE dial is delivered to the output terminal. (Requires 0.5 seconds for safety ground test before H.V. is applied)

**4 TIMER ON/OFF switch:**

To select whether the timer is to be used or not. If the switch is set for ON, the test is executed for the period set by the timer. If it is set for OFF, the test is executed continuously until the NG judgement is made or a reset signal is applied.

**5 TEST VOLTAGE dial:**

For setting the withstanding test voltage. The "C.C.W." position is for the minimum output and the voltage increases as this dial is turned clockwise. Be sure to keep this dial in the C.C.W. position whenever no test is being done.

**6 REMOTE CONTROL connector:**

When the instrument test is remote controlled, the plug of the test probe is connected to this connector.

**7 TEST ON lamp:**

This red lamp indicates that the test voltage can be delivered to the OUTPUT terminal simply by turning

⑤ TEST VOLTAGE DIAL or the the test voltage is being delivered.

**8 OUTPUT terminal:**

The hot line of the test output voltage.

**9 GND terminal: (1)**

The ground line of the test output voltage. Electrically, this line is connected to the instrument chassis.

CHASSIS GROUND: (2)

Connect the chassis of the device under test to this terminal. The lead used should be of low resistance and preferably as short as possible.

**10 CURRENT MONITOR terminals:**

The cutoff current can be directly monitored by disconnecting the shorting bar from these terminals and connecting a milliammeter (DC/AC) between them. The milliammeter should be capable of measuring the cutoff current. Be sure to connect the shorting bar when no milliammeter is connected between these terminals.

**11 Voltmeter:**

Indicates the output voltage (the voltage of the high voltage output terminal).

**12 TEST VOLTAGE selectors**

- AC/DC switch:

To select the AC mode or the DC mode for the test voltage.



- 1.5 kV/5 kV switch:

This switch is to select a test voltage range. It is linked to the voltmeter range selector.

#### INDICATOR LAMPS

- TEST VOLTAGE, 1.5 kV/5 kV

These red lamps indicate the test voltage range selected.

- AC/DC

These lamps indicate whether the test voltage is AC or DC.

- TEST RESULT, GOOD/NG

The GOOD lamp turns on if the result of judgement is good or the NG lamp turns on if it is no good. The NG lamp lights continuously, while the GOOD lamp lights only for about 0.5 sec. If the timer is not used for test, the GOOD judgement is not done.

- PROTECTION

When in any of the following cases, the Tester is driven into the protected state and the output is cut off. When this state has occurred, eliminate the cause of trip of the protective circuit and then press the RESET button to reset the Tester.

- (1) When the TEST VOLTAGE selector ( AC/DC switch or 1.5kV/5 kV switch) is operated for test mode change. (When the selector is turned to the OFF position.)
- (2) When the REMOTE PROTECTION input terminals are made open.
- (3) When the power switch is turned on again after turning it off only for a short period of time.
- (4) When the cutoff current is set at 100 mA in the DC mode. (GPT-515AD only) .
- (5) When in the AC mode the cutoff current is set at 100 mA and the MULTIPLIER function is effected.

**13 TIMER :**

For test time setting. The center knob is for time setting.

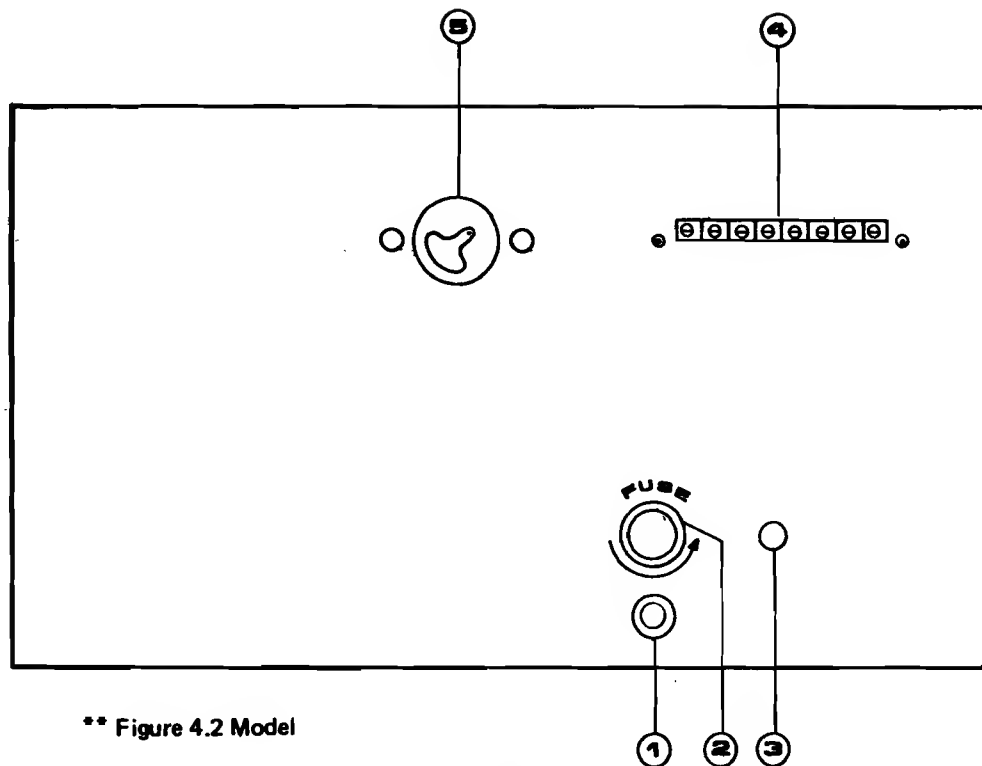
**14 CUTOFF CURRENT (mA) :**

This push switch is to set the leak current detection reference value to the 0.5, 1, 2, 5, 10, or 100 mA. If a leak current larger than the set reference value flows in the tested object, the tester makes the NG judgement, cuts off instantaneously its output, and generates the NG alarm signal.

**15 MULTIPLIER :**

This control is capable of multiplying the reference value by a factor of up to 2.5 times continuously variably. In this case, the scales are non-calibrated. The values set by the CUTOFF CURRENT knob are as calibrated with the MULTIPLIER knob set in the CAL position.

## 4-2 Description of Rear Panels



**\*\* Figure 4.2 Model**

- 1 AC 110V, 200V, 220V, 240V 50/60 Hz  
The AC input power cord of the instrument.
- 2 Fuse  
Fuse of the AC power line.
- 3 GND terminal:  
To ground the instrument to an earth ground. Be sure to ground the instrument to the earth via this terminal.
- 4 Signal output and remote protection input terminal block.
  - SIGNAL OUT terminals:  
These terminals provide three types of output signals, namely, TEST signal, GOOD signal, and NG signal. For details, refer to Item "Output Signals" of Section 4.3.
- 5 BUZZER loudness control:  
Controls the loudness of sound of the NG/GOOD buzzer.

### **4.3 Operating Procedure**

#### **Procedure Before Test**

- (1) Before turning on the instrument power switch, check that the voltmeter is indicating the "0" position, adjust it to this position with its mechanical zero adjustment at its center. If the instrument power has been on, turn it off and then check the meter.
- (2) After thoroughly reading and noting the items of Section 3.2 "Precautions for Operation", turn on the POWER switch and proceed as explained in this section.
- (3) If the PROTECTION indicator lamp on the front panel is lighted, the test is disabled and no test is executed even when the TEST button is pressed. The conditions of lighting of this indicator lamp are as mentioned in Item 12 of Section 4.1. To execute the test, eliminate the condition which causes lighting of this lamp and then press the RESET button to reset the instrument.

#### **Withstanding Voltage Test Procedure**

- (1) Selecting the test voltage mode (GPT-515AD):  
Select the AC or the DC mode with the TEST VOLTAGE AC/DC switch as required by the object to be tested.
- (2) Precautions for test in the DC mode (GPT-515AD):  
Note that a substantial time may be required before the electric charges stored in the filter capacitors of the Tester and capacitive components of the tested object are completely discharged. That is, once the Tester has been set to the TEST ON mode and the capacitive components have been charged up,

the voltage of the output circuit does not instantaneously fall to zero. Before touching the output terminals, test probe, or the tested objected, make it double sure that the instrument is not in the TEST ON state and the output voltmeter indication is zero.

**(3) Selecting the test voltage range:**

Select the test voltage range at 1.5 kV or 5 kV with the TEST VOLTAGE selector switch, as required by the tested object. The corresponding one of the TEST VOLTAGE indicator lamps will lights.

**(4) Setting the leak current limit reference value:**

Push the LEAK CURRENT switch, set the leak current limit reference value as required by test object.

**(5) Setting the test time:**

Set the test time with the timer, as required by the tested object.

**(6) Setting the test voltage:**

Set the TIMER ON/OFF switch to the OFF state. If the PROTECTION lamp is not lighted, check that the TEST VOLTAGE dial is at the counterclockwise extreme position, and then press the TEST button. Gradually turn clockwise the TEST VOLTAGE dial to set the required test voltage. Press the RESET button to cut off the output and then set the TIMER ON/OFF switch to the ON state.

**(7) Connecting the tested object:**

First of all, make sure that "the output voltmeter indication is "0" and "the TEST ON lamp is OFF." Next, connect the high voltage-side leadwire to the GND terminal of the Tester and, with this probe, short the high voltage output terminal of the Tester to make sure that it is not charged to a high voltage. Next, connect the GND-side test leadwire to the GND terminal of the Tester then connect the high-voltage-side leadwire to the high voltage output terminal of the Tester. Connect the GND-side leadwire to the tested object chassis then connect the high-voltage-side leadwire to the tested object.

**(8) Test with using the timer procedure:**

- (a) Press the TEST button so that the test operation commences.**
- (b) When the period set by the timer has elapsed, the test voltage is cut off and the GOOD signal is generated in the forms of lamp and buzzer and make-contact signal for about 0.5 sec.**
- (c) When a leak current larger than the limit value set by the LEAK CURRENT switch has flowed, the NG judgement is done and the output is instantaneously cut off and the NG alarm signals with a lamp, buzzer and make-contact are generated. Different from the case of the GOOD signal, the NG alarm signals continue until the instrument is reset.**
- (d) When the test in progress is needed to be stopped (the output voltage is needed to be cut off) due to any reason, press the RESET button.**

**(9) Test without using the timer:**

- (a) The timer of the instrument is for 3 minute maximum. When a test time longer than this or that of unpredictable time is needed, perform the test without using the timer. When a test is done with the LEAK CURRENT RANGE 100 mA setting, however, a continuous test of up to 30 minutes can be done. This, however, does not apply when the set range is 10 mA or lower.
  - (b) Set the TIMER ON/OFF switch to the OFF position.
  - (c) Connect the tested object to the output terminals of the instrument as explained in Step (7).
  - (d) Check that the TEST VOLTAGE dial is at the counterclockwise extreme position and then press the TEST button. The TEST ON lamp will light to indicate that the test voltage is ready to apply. Gradually turn clockwise the TEST VOLTAGE dial until the necessary test voltage is obtained. When the required test time has elapsed or when the required condition is obtained, press the RESET button. In this case the GOOD signal is not generated.
  - (e) If the NG alarm signal is generated in the above test, the instrument operations are the same with those occur when the test is done using the timer.
- (10) Re-application of test voltage (retest):
- If the instrument is in the reset state, the test voltage as set by the TEST VOLTAGE dial is delivered to the output terminal simply by pressing the TEST button. If the instrument is generating the NG alarm signal or is in the PROTECTION state, press the RESET button to reset the instrument.



### **GO—NOGO Judgement (Judgement Errors)**

**(1) GO—NOGO judgement function:**

The instrument makes a **GOOD** judgement only when the measured value is lower than the set value. That is, it makes an **NG** judgement when the leak current (measured value) is larger than the set value.

### **Remote Control**

- (1) The test operation of this instrument can be remote-controlled with the remote high probe. As the plug of the remote control cable is connected to the REMOTE CONTROL connector on the instrument front panel.**

### **Output Signals**

- (1) The Tester provides the following signals in addition to the lamp and buzzer signals.**

<b>Name of signal</b>	<b>Condition for generating the signal</b>	<b>Type of signal</b>
<b>TEST</b>	<b>During test period</b>	
<b>GOOD</b>	<b>For 0.5 sec when test is over</b>	<b>Make-Contact</b>
<b>NG</b>	<b>When NG judgement is made</b>	<b>Signal</b>

1. **TEST ON signal:** This signal is generated and remains on for the entire period of the test.
2. **GOOD signal:** This signal is generated when the GOOD judgement is done at the end the test with the timer. The signal lasts for approximately 0.5 sec.
3. **NG signal:** This signal is generated when the NG judgement is done. The signal lasts until the next RESET signal is applied.

## **5. MAINTENANCE**

### **5.1 Cautions**

A hazardously high voltage of a level of 5 kV is generated by this instrument. Never attempt to repair the instrument for yourself. For such service, contact your GOOD WILL agent.

This section covers the calibration procedure of the instrument. Be extremely careful not to touch the electrically charged parts.

### **5.2 Calibration**

This section explains the calibration procedures of the voltmeter and the CUTOFF CURRENT value.

#### **(1) Meters and Resistors Required for Calibration**

1. **Voltmeter I:** A voltmeter which is capable of measuring 5 kV, AC (50/60 Hz) and DC, with an accuracy of approximately 1%.
2. **Voltmeter II:** A voltmeter which is capable of measuring 2.5 V DC, with an accuracy of 0.1%.
3. **Milliammeter:** A milliammeter which is capable of measuring 0.5, 1, 2, 5, 10, and 100 mA AC

(50/60 Hz) and DC, with an accuracy of approximately 1%.

4. Load resistors: Resistors as shown in Table 5.1, for calibration of CUTOFF CURRENT values. The resistors for the points the calibration of which is omitted are not required.

Table 5.1

Cutoff current ( mA )	Load resistor	
	Resistance ( $\Omega$ )	Power Consumption ( W )
0.5	2M	0.5
1	1M	1
2	500K	2
5	200K	5
10	100K	10
100	10K	100

Note 1: The working voltage ratings of the resistors must be 1 kV AC or over. The accuracies of resistances must be 5% or better.

Note 2: The resistances must have wattages with sufficient allowances for the above-mentioned power consumptions.

**(2) Preparation and Notes Before Starting Calibration**

1. Before turning on the power switch, perform mechanical zero .
2. Turn on the power switch and allow a stabilization period of approximately 15 minutes or over.
3. The Testers can be operated either with an AC or an DC output voltage, by switching. In the subsequent explanation, the output voltage mode is not discriminated between AC and DC. Use a voltmeter and a milliammeter corresponding to the output voltage mode. The calibration methods are identical for both modes but the parts numbers of the semi-fixed potentiometers for the AC mode are different enclosed in brackets, hereafter.
4. The semi-fixed potentiometers are located on the PC board at the left-hand side in the casing. The layout of the potentiometers is shown in adjustment component locations.

**(3) Calibration of Voltmeter**


1. Set the switches and knob on the front panel of the Tester as follows:
  - TEST VOLTAGE switch: 1.5 kV
  - TIMER ON/OFF switch: OFF
  - TEST VOLTAGE knob: Counterclockwise extreme position.
2. Connect a standard voltmeter to the output terminal, set the Tester to the TEST ON state, and adjust the output voltage of the Tester so that the standard voltmeter indicates 1.5 kV.
3. Adjust SVR110 (SVR112) so that the pointer of the voltmeter of the Tester is deflected to the center of the 1.5 kV scale position.
4. Reduce the output voltage to zero and change the TEST VOLTAGE switch to the 5 kV position.
5. In a similar procedure as in Steps 2. and 3. calibrate the 5 kV range of the voltmeter with SVR113 (SVR111). After the calibration is over, turn the TEST VOLTAGE dial to the counterclockwise extreme position and press the RESET button.

(4) Check of Voltmeter Indications

1. At each of the 1.5 kV/5 kV ranges of AC/DC modes, check the indication of the Tester voltmeter with the standard voltmeter.
2. Check the indications at the following measuring points:
  - 1.5 kV range: 0.5, 1, 1.5 kV
  - 5 kV range: 1, 2, 3, 4, 5 kV

Measuring points may be omitted, added, or changed depending on the purpose of calibration.

(5) Calibration of Cutoff Current (Leak Current Detection Sensitivity)

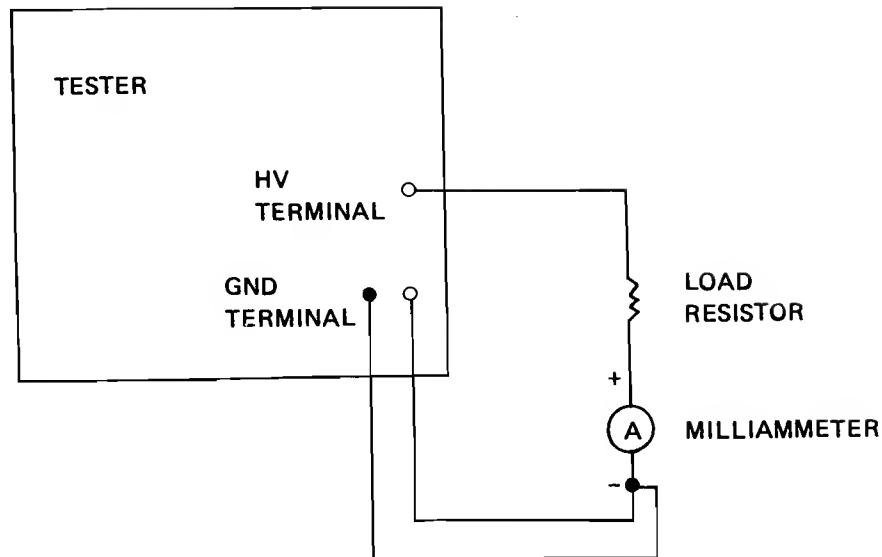
1. Set the MULTIPLIER knob on the front panel of the Tester to the CAL'D position.
2. Measure the voltage of pin 3 of U101 with reference to  Adjust the voltage to  $2.5 \text{ V} \pm 5\%$  with SRV108.

(6) Check of Cutoff Current (AC)

1. Set the panel switches and knobs in the same manner as mentioned in Item (3), 1.
2. Connect a load resistor and a milliammeter which are corresponding to the set cutoff current, as shown in Figure 5.1 or 5.2. Select a resistance from Table 5.1 in conformity with the set current.
3. Set the Tester to the TEST ON state and gradually increase its output voltage until the Tester generates the NG signal at approximately 1 kV. Turn slightly the TEST VOLTAGE dial counter-clockwise, set the Tester again to the TEST ON state, and increase the output voltage very slowly.
4. Read the current immediately before the NG signal is generated and the output is cut off. (Adjustment SVR101-SVR106)

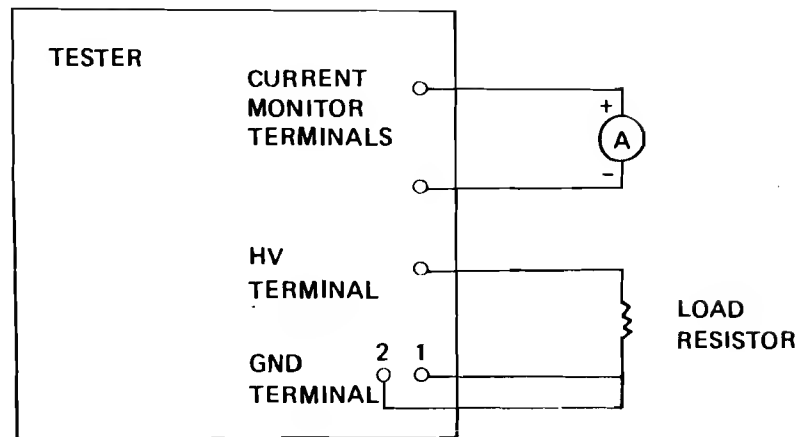
5. For each of the cutoff current values to be tested, repeat the procedure of Steps 3. — 5.
6. Check of cutoff current (DC)  
Adjustment SVR107 for the correctly reading. (Set cut-off current in 10 mA Range)
7. Safety ground adjustment
  - (I) Connect a standard resistance ( $0.5\ \Omega$  1%, 1W) to the GND (1 and 2) terminal, set the Tester to the TEST on state.
  - (II) Adjustment SVR109 for the protection light to turn on.

**\*\* Figure 5.1**



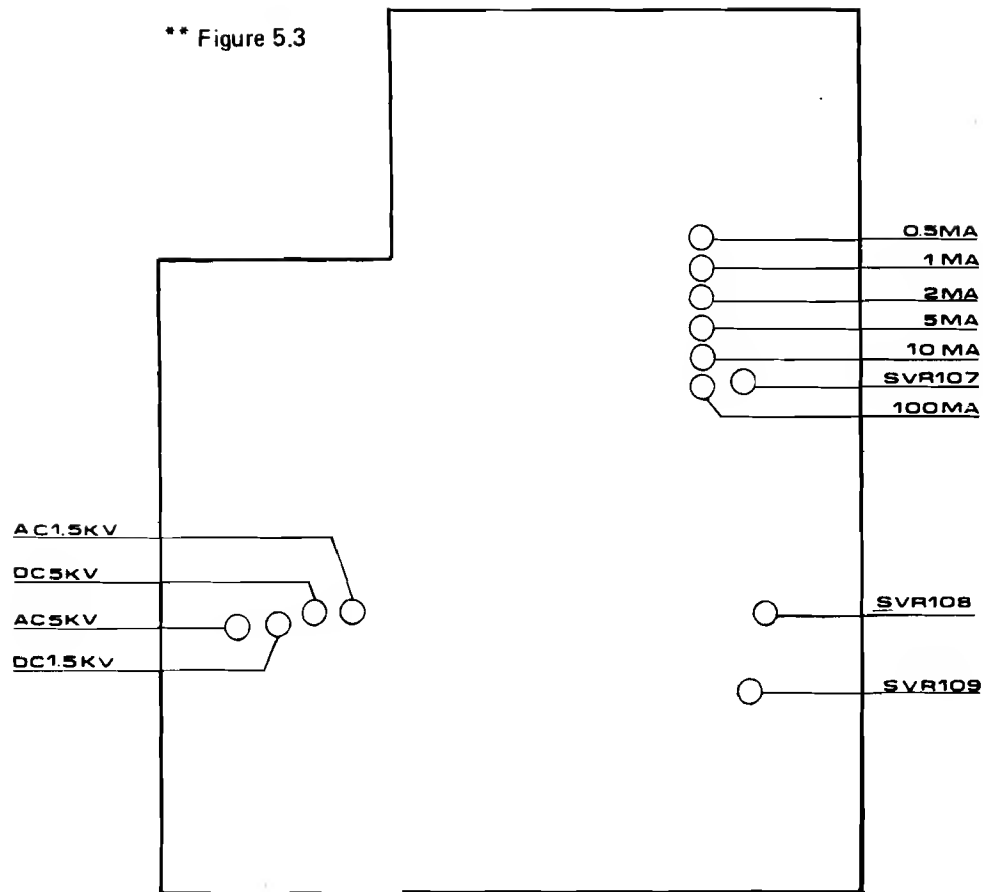
**\* Be sure to connect the milliammeter to the GND terminal side.**

\*\* Figure 5.2





**\*\* Figure 5.3**



**ADJUSTMENT COMPONENT LOCATIONS**

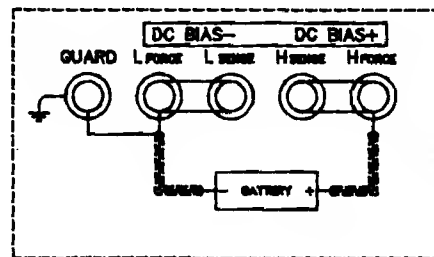
4. When measuring a low impedance (small inductance, resistance or high capacitance) measurement error as:
  - Residual impedance of test lead during two terminal measurement.
  - Mutual test lead induction between force leads and sense leads.
  
5. When measurement a high impedance measurement error is stray capacitance between H and L leads.
  1. Use test leads in four-terminal configuration and measure.
  2. Twist force leads together. Do the same with sense leads.
  3. Attititional error is presented as  $W^2 L_r C_x \times 100\%$  for C measurement. where  $W = 2\pi f$ ,  $f = \text{TEST FREQUENCY}$ ,  $L_r = \text{RESIDUAL INDUCTANCE}$ ,  $C_x = \text{UNKNOWN CAPACITANCE}$ .
  
6. Excessive measurement error.
  1. Use shielded cable for connection between sample and UNKNWON terminal. Connect outer conductor to GUARD.
  
1. Effect of low terminal capacitance with respect to ground. Sometimes the measurement can not be performed when a relatively large capacitance between L sense terminal and ground exists, allowable magnitude for the stray capacitance without additional error are:
 

120Hz.....	100nF
1kHz.....	1000PF

2. Effect of high terminal capacitance with respect to ground. The stray capacitance will reduce test signal level applied to the sample measured during capacitance measurement. This decrease in signal level will not produce an additional error even when measurement signal level is reduced to a third of its nominal level. It is necessary, of course, that special care be taken to use the proper test signal level when a device is measured whose parameters may be affected by the test signal level. Display fluctuations may sometimes appear.
7. When a sample is measured in AUTO of CIRCUIT MODE, the instrument repeats range selection and does not complete the measurement depending upon level of test current used. (Example, an iron core inductor)
1. Try to determine the range that measures that sample properly by repeating HOLD an AUTO operation several times. Most operations are on HOLD mode for these cases.

8. Internal resistance of a battery can not be measured.

1. Connect sample battery as illustrated below:



2. Battery up to 30V are measured under no load conditions.
3. If battery voltage exceeds 4V, set DC bias to EXT and disconnect shorting bar from EXT DC bias connect on rear panel.
4. Since the internal resistance of a battery is relatively very low, use the four-terminal measurement configuration.

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